REMARKS

Claims 3-10 are currently pending. Claims 1 and 2 are cancelled and the rejections with regard to these claims are now moot. Claims 3-9 are currently amended. Support for the amendments to Claims 3 and 4 can be found at, for example, paragraphs [0127] and [0128] at Table 6 in the first row for Steel N and at Table 7 in the first row for Steel N at the column describing the "Nitrogen content in interior of steel sheet (ppm)." The amendments to Claim 5 merely alter the independent claims identified in this claim. Support for the amendments to Claims 6-9 can be found at, for example, paragraphs [0120], paragraphs [0125], [0126], [0127], [0128] and in Tables 3-7.

Claims 3-5 have been rejected under both 35 U.S.C. §102(b) as being inherently anticipated by Takajo and as obvious under 35 U.S.C. §103(a) over Takajo. The rejection states that Takajo does not disclose steel sheets comprising a "number of nitrides containing chromium per mm^2 in the interior of the steel sheet [that] is 2,500 or less." The rejection also states that the steel sheets disclosed in Takajo describe the alloy compositions of the Applicants' claims, the disclosed steel sheets have an electrical resistance of 60 $\mu\Omega$cm or more, and that Takajo discloses a method of making these steel sheets in an atmosphere of 100% hydrogen. Last, the rejection states the steel sheets of Takajo would be expected to possess the same properties as the claimed compositions including comprising a number of nitrides containing chromium per mm^2 in the interior of the steel sheet that is 2,500 or less.

The Applicants' subject matter relates to achieving high-frequency magnetic properties in a non-oriented electrical steel sheet comprising 2.5% by mass or more Si and 1.5% to 20% by mass Cr to produce excellent magnetic properties, and a steel sheet in which the number of nitrides containing chromium per mm^2 in the interior of the sheet is carefully controlled to be 2,500 or less.

Unlike Takajo, the Applicants' claims are characterized by the addition of 0.1% to 2% by mass Al to control and suppress the formation of chromium nitride precipitates so that only an extremely small of amount of such nitrides are present in the Applicants' steel sheets. Such nitrides are formed by two processes. The first, is the entry of nitrogen and nitrides from outside the steel sheet during annealing. The second, is from nitrogen and nitrides contained in the ingots used as the source material for forming a steel sheet.

Normally, the amount of nitrogen or nitrides contained in the ingot source material must be 0.002% by mass (20 ppm) or less if one wants to make a steel sheet in which the number of

nitride precipitates containing chromium per mm^2 in the interior of the sheet is to be 2,500 or less. However, chromium nitrides in the interior of the sheet can be kept below 2,500 or less using the Applicants' compositions and methods--even with materials having N contents greater than 0.002% by mass. This is because the formation of chromium nitrides is controlled, in large part, by the Al included in the claimed compositions and used in the claimed methods.

The effect of Al in preventing chromium nitride formation is readily apparent from Table 1 below. Comparison of Steels E (3rd), F (4th), and F (5th) with steels J (2nd), N (2nd), I (1st), and G (2nd) in Table 1 shows that the number of chromium nitrides per mm^2 in steel sheets with less than 0.1% by mass Al and a N content of greater than 0.002% (20 ppm) by mass results in more than 2,500 chromium nitrides per mm^2, while the Applicants' compositions having more than 0.1% Al by mass and a N content ≥0.002% (20 ppm) by mass have less than 2,500

Table 1

Steel ID	Tabulated in	Al content (mass%)	N content in product steel sheet (ppm)	Number of nitrides containing Cr (number/$mm^{2)}$	Remarks
E (3^{rd})	Table 4	0.005	22	7,500	Comparative example
F (4^{th})	Table 4	0.005	25	12,000	Comparative example
F (5_{th})	Table 4	0.005	28	22,000	Comparative example
J (2^{nd})	Table 5	0.65	21	<100	Inventive example
N (2^{nd})	Table 6	0.5	25	<100	Inventive example
1(1^{st})	Table 5	0.35	28	<100	Inventive example
G (2^{nd})	Table 5	0.55	30	1,200	Inventive example

chromium nitrides per mm^2. Stated differently, it is impossible to reduce the number of nitrides containing chromium per mm^2 in the steel sheet to 2,500 or less with a N content of greater than 0.002% by mass and a Al content of less than 0.1% by mass.

Furthermore, Takajo teaches Steel 8 in Table 3 which contains 0.0036% by mass N (36 ppm) and less than 0.1% by mass Al. As the data in Table 1 above clearly demonstrates such a composition would contain more than 2,500 chromium containing nitrides per mm^2. Takajo also teaches at paragraph [0023] that the steels disclosed therein must be produced using N contents of less than 0.0012% to 0.0018% by mass (12 ppm to 18 ppm) and one of ordinary skill in the art, given the data in Table 1 above, would not necessarily expect steel sheets having 21 ppm or more N content to have less than 2,500 chromium containing nitrides per mm^2.

Consequently, the result of reducing the number of nitrides containing chromium per mm^2 in the steel sheet to 2,500 or less in the claimed compositions and methods is not disclosed or suggested in Takajo. Therefore, the compositions and methods of Claims 3-10 are not necessarily disclosed in Takajo. In other words, Takajo cannot inherently anticipate or render obvious the claimed compositions and methods.

Amended Claims 3-5 are not inherently anticipated under 35 U.S.C. §102(b) by Takajo. The rejection acknowledges that Takajo does not teach a "number of nitrides containing chromium per mm^2 in the interior of the steel sheet [that] is 2,500 or less[,]" and instead relies on an inherency argument to supply this element of Claims 3-5. The fact that a certain characteristic may by present in the prior art is not sufficient to establish the inherency of that characteristic. *See* In re Rijckaert, 9 F.3d 1531 (Fed. Cir. 1993). To establish inherency any missing descriptive matter must necessarily be present in the compositions described in a reference and also must be recognized by persons of ordinary skill in the art. *See* In re Roberston, 169 F.3d 743, 745 (Fed. Cir. 1999). Inherency cannot be established by mere "probabilities or possibilities." *See* In re Roberston, 169 F.3d 743, 745 (Fed. Cir. 1999).

As shown in Table 1 above, the compositions of Takajo do not all necessarily contain a "number of nitrides containing chromium per mm^2 in the interior of the steel sheet [that] is 2,500 or less." Instead, Table 1 shows that certain of these compositions contain a number of nitrides containing chromium per mm^2 in the interior of the steel sheets that is much greater than 2,500. The compositions of Takajo and the claimed compositions are also made using substantially different starting materials and processes. This is important, because these differences introduce multiple variables which might, or might not, produce steel sheets having a number of nitride precipitates containing chromium per mm^2 in the interior of the steel sheet that is more than, or less than 2,500. Either way it cannot be said with any certainty that the steel sheets of Takajo, which were manufactured using substantially different starting materials and processes, must necessarily have a number of nitride precipitates containing chromium per mm^2 in the interior of the steel sheet that is less than 2,500. This is because the formation of precipitates, like crystal formation, is dependent on a host of different variables including, for example, the presence of condensation nuclei, the annealing temperatures, cooling rates, the length of time annealing is performed, as well as the crystalline matrix or solution in which the precipitates are formed. One skilled in the art would also not recognize, or otherwise acknowledge, that the steel sheets of Takajo made using different manufacturing techniques and starting materials must contain a

"number of nitrides containing chromium per mm^2 in the interior of the steel sheet [that] is 2,500 or less." Consequently, Takajo does not anticipate the compositions of amended Claims 3-5 because it does not describe all of their elements either expressly or inherently. The Applicants respectfully request withdrawal of the rejections of amended Claims 3-5 under 35 U.S.C. §102(b) by Takajo.

Amended Claims 3-5 are not obvious under 35 U.S.C. §103(a) over Takajo. As discussed above, Takajo fails to expressly or inherently teach all the elements of the compositions of amended Claims 3-5, and fails to establish one of ordinary skill in the art would recognize, or otherwise acknowledge, that the steel sheets of Takajo made using different manufacturing techniques and starting materials <u>must</u> contain a "number of nitrides containing chromium per mm^2 in the interior of the steel sheet [that] is 2,500 or less." Furthermore, it is self evident to state:

> "That which <u>may be</u> inherent is not necessarily know. Obviousness cannot be predicated on what is unknown."

See <u>In re Spormann and Heinke</u>, 150 U.S.P.Q. 499, 452 (CCPA 1996) (emphasis added). Consequently, the rejection fails to establish that the combination of Takajo and the knowledge available to one of ordinary skill in the art would teach all the elements of the compositions of amended Claims 3-5. In light of the forgoing the applicants respectfully request withdrawal of the rejections of amended Claims 3-5.

Claims 6-10 have been rejected under both 35 U.S.C. §102(b) as being inherently anticipated by Takajo and as obvious under 35 U.S.C. §103(a) over Takajo. The arguments of the rejection are essentially identical to those described above for the rejection of Claims 3-5 over Takajo.

The methods of amended Claims 6-9 and Claim 10 produce a steel sheet having a decrease in high-frequency iron loss caused by chromium containing nitride precipitates even when annealing is conducted in an atmosphere comprising 60 percent or more by volume of a nitriding gas and less than 95 percent by volume (5 percent or more and 30 percent more in case of Claim 6) in total in terms of nitrogen gas. These methods unexpectedly produce such high quality steel sheets even when a portion of the annealing atmosphere is replaced with an inexpensive nitriding gas.

For example, in the method of amended Claim 7 adding an appropriate amount of Sb and/or Sn in an Al free composition suppresses the generation of nitrides containing chromium during finish annealing performed in an atmosphere of high N_2 (*e.g.* 60% to 95% by volume). Importantly, this method lowers costs and permits the manufacture of high quality steel sheets with excellent magnetic properties.

Furthermore, in the method of amended Claims 8 and 9 adding an appropriate amount of Al, Sn or Sb suppresses the generation of nitrides containing chromium during finish annealing performed in an atmosphere of high N_2 (*e.g.* 60% to 95% by volume). Importantly, this method also lowers costs and permits the manufacture of high quality steel sheets with excellent magnetic properties. See Table 2 below.

Table 2 (4.4-4.5% Si steel)

	Data	Al (mass%)	Sn or Sb (mass%)	N_2 partial pressure (vol%)	Number of nitrides containing Cr (number/mm^2)	Iron loss $W_{10/1k}$ (W/kg)
Present application	Steel Q in Table 7 (1st)	0.005	Each ≤0.001	70	1,500,000	37.08
	Steel R in Table 7 (1st)	0.005	Sn:0.03	70	<100	27.95
	Steel T in Table 7 (1st)	0.45	each ≤0.001	70	<100	27.12
	Steel T in Table 7 (2nd)	0.45	each ≤0.001	0	<100	27.04

Additionally, a composition that prevents the generation of nitrides containing chromium, such as the composition used in the method of Claim 6, can be used even when nitriding gases are present in amounts less than 30% by volume or 5% by volume to produce steel sheets having the desired magnetic properties. Different compositions, such as Steel Q in Table 7, cannot produce such steel sheets in these atmospheres. *See* Table 2 above.

It is well known in the field of mass production of steel sheet that the consumption of annealing atmosphere gas is very high. Consequently, substantial cost increases will occur unless low cost atmospheric gases such as nitrogen can be used in such methods of steel sheet production. Clearly, utilization of nitriding gases without compromising steel sheet quality has substantial industrial advantages.

In Takajo, there is no teaching or suggestion that nitriding gases can be used in a method of making steel sheets without a deterioration of the magnetic properties of such steel sheets being caused by the formation of nitride precipitates containing chromium during annealing. Instead, Takajo merely teaches final annealing in an atmosphere of 100% hydrogen gas. Consequently, Takajo does not teach the elements of the claimed methods. Therefore, Takajo does not inherently anticipate Claims 6-10 under 35 U.S.C. §102(b) or render these claims obvious under 35 U.S.C. §103(a).

Amended Claims 6-9, and Claim 10 are not inherently anticipated under 35 U.S.C. §102(b) by Takajo. In the methods of amended Claims 6-9 the "final annealing atmosphere" contains "5 percent by volume or more and less than 30 percent by volume in total terms of nitrogen gas[,]" or "60 percent by volume or more and less than 95 percent by volume in total in terms of nitrogen gas[.]" Claim 10 is dependent on amended Claims 6-9 and incorporates the recitations of these claims. Takajo only teaches methods of steel sheet production in which the final annealing atmosphere is 100% hydrogen and does not teach a final annealing atmosphere comprising nitrogen or other nitriding gases. Consequently, Takajo does not anticipate the methods of amended Claims 6-9 and Claim 1 because it does not describe all the elements of the claimed methods either expressly or inherently. The Applicants respectfully request withdrawal of the rejections of amended Claims 3-5 under 35 U.S.C. §102(b) by Takajo.

Amended Claims 6-9, and Claim 10 are not obvious under 35 U.S.C. §103(a) over Takajo. As discussed above, Takajo fails to teach all the elements of the method of amended Claims 6-9 and Claim 10 either expressly, or inherently. Consequently, the rejection fails to establish that the combination of Takajo and the knowledge available to one of ordinary skill in the art would teach all the elements of the methods of amended Claims 6-9, and Claim 10. The Applicants respectfully request withdrawal of the rejections of amended Claims 6-9, and Claim 10.

In light of the foregoing, the Applicants respectfully submit that the entire Application is now in condition for allowance, which is respectfully requested.

Respectfully submitted,

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